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ON THE CONSTRUCTION OF THE PARABOLAS GIVEN BY FOUR POINTS.

By Prof. E. W. Hyde, Cincinnati, Ohio.

Salmon, in his Conic Sections, gives several solutions of the problem of constructing a conic when four points and a tangent are given, which of course includes the above problem, since the line at ∞ in the plane of the curve is a tangent to it. His solutions, however, depend on Carnot's theorem, or the use of the properties of points in involution.

The following method is a direct and simple application of Pascal's theorem, which recently occurred to me. It consists in finding the direction of the double point at ∞; that is, of the axis of the parabola. There are two solutions, as will appear. Let the given points be 1, 2, 3, 4, and call the point and line at ∞ p_∞ and L_∞, respectively. Then the sides of the Pascal hexagon may be taken as $\frac{12}{4p_\infty}$, $\frac{23}{L_\infty}$, $\frac{34}{p_\infty 1}$, in order; and the three points $(12 . 4p_\infty)$, $(23 . L_\infty)$, $(34 . 1p_\infty)$ must lie on one line, say A. Hence we have to draw through 1 and 4, respectively, two parallel lines, $1p_\infty$ and $4p_\infty$, cutting 34 and 12 in points 6 and 7, such that 67, *i. e.* A, shall be parallel to 23. To find the point 6, let $A3 = a'$, $A4 = a$, $A2 = b'$, $A1 = b$, $A5 = a_1$, $A6 = x$, and $A7 = y$. Then by similar triangles we must have

$$\frac{x}{y} = \frac{a'}{b'} \qquad \text{and} \qquad \frac{x}{a} = \frac{b}{y};$$

whence

$$x = \pm\sqrt{a \cdot \frac{ba'}{b'}} = \pm\sqrt{aa_1}.$$

The distance $a_1 = A5$ is constructed at once by drawing 15 parallel to 23; then draw a circle with diameter $A4$, and erect at 5 a perpendicular to $A4$, cutting the circle in 9; with $A9$ as radius, draw circle cutting $A4$ in $A6$ $(= x)$ and $A8$ $(= -x)$; then 16 and 18 are parallel to the axes of the two parabolas. Having the point at ∞ for each parabola, we have five points, and can apply Pascal's theorem in the usual way to construct the curve.